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Multi-Point Dieless Forming Product Defect Reduction Using Reliability-Based Robust Process Optimization

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Abstract : The product quality of multi-point dieless forming (MDF) is identified to be dependent on the process parameters. Moreover, a certain variation of friction and material properties may have a substantially worse influence on the final product quality. This study proposed on how to compensate the MDF product defects by minimizing the sensitivity of noise parameter variations. This can be attained by reliability-based robust optimization (RRO) technique to obtain the optimal process setting of the controllable parameters. Initially two MDF Finite Element (FE) simulations of AA3003-H14 saddle shape showed a substantial amount of dimpling, wrinkling, and shape error. FE analyses are consequently applied on ABAQUS commercial software to obtain the correlation between the control process setting and noise variation with regard to the product defects. The best prediction models are chosen from the family of metamodels to swap the computational expensive FE simulation. Genetic algorithm (GA) is applied to determine the optimal process settings of the control parameters. Monte Carlo Analysis (MCA) is executed to determine how the noise parameter variation affects the final product quality. Finally, the RRO FE simulation and the experimental result show that the amendment of the control parameters in the final forming process leads to a considerably better-quality product.

Keywords : dimpling, multi-point dieless forming, reliability-based robust optimization, shape error, variation, wrinkling
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